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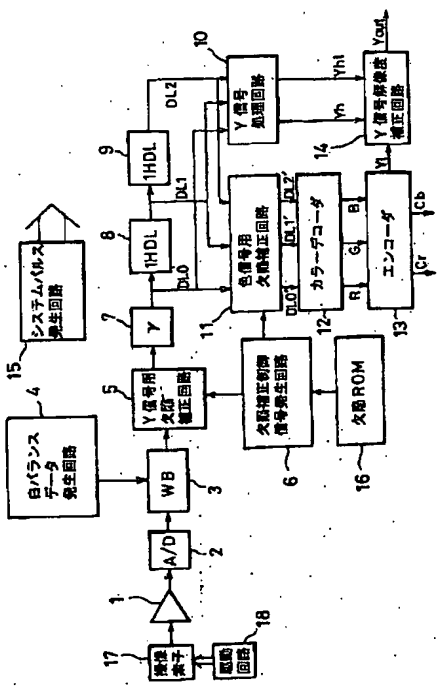
(54)【発明の名称】　カラー撮像素子の欠陥補正装置

(57)【要約】

【課題】　カラー撮像素子の欠陥補正装置において、輝度信号の高解像度成分を失うことなくかつ欠陥が目立たないように補正を行なう。

【解決手段】　それぞれ所定の色の色フィルタを全面に配置した複数の画素を備えた単板カラー撮像素子のための欠陥画素の信号を補正する装置である。該装置は、欠陥画素の位置を示す信号を出力する欠陥データ発生装置６，１６、欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号または該信号の平均で置き換えて補正する輝度信号用欠陥補正装置５、および輝度信号用欠陥補正装置５からの信号を受け入れて欠陥画素の信号をその近傍の同じ色の画素の信号もしくは同じ色の複数の画素の信号の平均で置き換えて最補正を行なうことにより色信号の補正を行なう色信号用欠陥補正装置１１とを備える。



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【特許請求の範囲】

【請求項１】　それぞれ所定の色の色フィルタを前面に配置した複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置であって、

欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、

前記輝度信号用欠陥補正装置とは別個に設けられ、欠陥補正された色信号を得るための色信号用欠陥補正装置と、

を具備することを特徴とするカラー撮像素子の欠陥補正装置。

【請求項２】　前記輝度信号用欠陥補正装置は欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで行い、前記色信号用欠陥補正装置は欠陥画素近傍の同じ色の画素の信号もしくは同じ色の複数の画素の信号の平均で置き換えることで行なうことを特徴とする請求項１に記載のカラー撮像素子の欠陥補正装置。

【請求項３】　それぞれ所定の色の色フィルタを前面に配置した複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置であって、

前記カラー撮像素子の欠陥画素の位置を示す信号を出力する欠陥データ発生装置と、

前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、

前記輝度信号用欠陥補正装置からの信号を受け入れて前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号を前記欠陥画素近傍の同じ色の画素の信号もしくは同じ色の複数の画素の信号の平均で置き換えて再補正を行なうことにより欠陥補正された色信号を得るための色信号用欠陥補正装置と、

を具備することを特徴とするカラー撮像素子の欠陥補正装置。

【請求項４】　前記カラー撮像素子からの信号に対してホワイトバランス処理を行った後に前記輝度信号用欠陥補正装置にて欠陥補正処理を行なうことを特徴とする請求項３に記載のカラー撮像素子の欠陥補正装置。

【請求項５】　前記輝度信号用欠陥補正装置は欠陥画素の信号を直前の画素の信号と置き換えることを特徴とする請求項３に記載のカラー撮像素子の欠陥補正装置。

【請求項６】　前記輝度信号用欠陥補正装置は欠陥画素の信号を直前および直後の画素の信号の平均信号で置き換えることを特徴とする請求項３に記載のカラー撮像素子の欠陥補正装置。

【請求項７】　前記色信号用欠陥補正装置は欠陥画素の

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信号を最も近い同色の前後の画素の信号の平均信号、または同色の斜め上下前後４か所の信号の平均信号で置き換えることを特徴とする請求項３～６のいずれか１項に記載のカラー撮像素子の欠陥補正装置。

【請求項８】　赤色と緑色の画素が交互に配置された第１の水平行と、緑色と青色の画素が交互にかつ緑色の画素は前記第１の水平行の緑色の画素の間の位置に対応して配置された第２の水平行とが交互に反復するよう配置された複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置であって、

前記カラー撮像素子の欠陥画素の位置を示す信号を出力する欠陥データ発生装置と、

前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、

前記輝度信号用欠陥補正装置からの信号を受け入れて前記欠陥データ発生装置からの信号に基づき欠陥補正された色信号を得るための色信号用欠陥補正装置であって、

注目水平行の両側の水平行では、欠陥画素の信号を水平前後２画素離れた画素の信号の平均で置き換え、注目水平行では、欠陥画素が赤色または青色の場合は該欠陥画素の信号を水平前後２画素離れた画素の信号の平均で置き換え、欠陥画素が緑色の場合は該欠陥画素の信号を斜め上下前後４か所の画素の信号の平均で置き換えて再補正を行なうことにより、欠陥補正された色信号を得るための前記色信号用欠陥補正装置と、

前記欠陥補正された注目水平行および該注目水平行の両側の水平行の補正された色信号を使用して各原色の色信号を出力する色分離回路と、

を具備することを特徴とするカラー撮像素子の欠陥補正装置。

【請求項９】　前記カラー撮像素子からの信号に対してホワイトバランス処理を行った後に前記輝度信号用欠陥補正装置にて欠陥補正処理を行うことを特徴とする請求項８に記載のカラー撮像素子の欠陥補正装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、カラー撮像素子の欠陥補正装置に関し、特に、カラー撮像素子の欠陥画素の信号を補正する場合に、輝度信号の高解像度成分が失われることなくかつ欠陥が目立たないように補正を行なう技術に関する。

【０００２】

【従来の技術】固体撮像素子は、その製造課程における異物の混入、傷その他により画素の欠陥が生じることがある。このような画素の欠陥としては、たとえば入射光のレベルにかかわりなく白レベルまたは黒レベルの信号

を出力する白点欠陥や黒点欠陥がある。このような画素の欠陥の内孤立した画素の欠陥については、従来より、欠陥画素に隣接する画素または周囲の画素からの信号に基づき生成した補完値で欠陥画素の信号を置き換えることで補正を行ない、撮像画像に欠陥画素の影響が生じないようにしていた。

【０００３】また、一枚の撮像素子の光入射面上に画素に対応してモザイク状もしくはストライプ状の色フィルタを配置してカラー画像を得る単板カラー撮像素子においては、通常、最隣接する画素は異なる色の画素であるため、欠陥画素の補正は該欠陥画素と同じ色の画素で最も近い画素によって補完することにより行なっていた。

【０００４】たとえば、図７に示すような、緑（Ｇ）市松、赤（Ｒ）青（Ｂ）線順次と呼ばれるフィルタ配列では、たとえば緑（Ｇ）の画素を補完するには斜め上下前後の同色の４画素の信号の平均や水平方向２画素前の同色の信号で置き換えることで行なわれていた。また、青（Ｂ）や赤（Ｒ）の画素は上下左右２画素離れた同色の４つの画素の信号の平均や水平方向に２画素離れた前後の同色の２つの画素の信号の平均で置き換えることで欠陥補正を行なっていた。そして、このようにして欠陥補正された各色の色信号からエンコーダにより輝度信号および必要な色差信号などを作成していた。

【０００５】

【発明が解決しようとする課題】しかしながら、カラー撮像素子に関する上に述べたような欠陥補正では、欠陥画素を補完するのに同じ色の離れた画素の信号で補完するから、各色の画素に含まれる輝度信号成分から生成される輝度信号の高解像度成分が失われてしまうという不都合があった。このため、たとえば色のない被写体であっても、その輪郭部に欠陥が当たった場合、輝度信号に大きな段差を生じ、欠陥が目立ってしまうという現象を起こしていた。

【０００６】本発明は、このような従来例における問題点に鑑み、カラー撮像素子の欠陥補正装置において、輝度信号の高解像度成分を失うことなく適切に欠陥補正ができるようにし、より欠陥が目立たないカラー撮像信号を生成できるようにすることにある。

【０００７】

【課題を解決するための手段】本発明の第１の態様では、それぞれ所定の色の色フィルタを前面に配置した複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置において、欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、前記輝度信号用欠陥補正装置とは別個に設けられ、欠陥補正された色信号を得るための色信号用欠陥補正装置とを設ける。

【０００８】即ち、欠陥補正された輝度信号を作成する信号処理には輝度信号用の欠陥補正装置によって欠陥補正を行ない、これとは別に設けられた色信号用欠陥補正装置により色信号に合わせた欠陥補正を行なう。これによって、輝度信号および色信号それぞれに最適の補正方法を使用することができ、より適切かつ欠陥の目立たない補正を行なうことができる。

【０００９】この場合、例えば、前記輝度信号用欠陥補正装置は欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで行い、前記色信号用欠陥補正装置は欠陥画素近傍の同じ色の画素の信号もしくは同じ色の複数の画素の信号の平均で置き換えることで行なうことができる。

【００１０】輝度信号に関しては、欠陥画素の色にかかわらず、隣接するたとえば左隣の画素から欠陥補正信号を得て欠陥画素の信号を置換することにより、輝度信号の高解像度成分はより多く保存され、高解像度成分が失われることが少なくなり輝度の欠陥としても目立たなくなる。また、色信号は欠陥画素と同色の近接する画素から欠陥補正信号を得て欠陥画素を置換し信号処理を行なうから、補正によって色が異なることもなくなり適切な補正が行われる。また、色信号はもともと解像度が低く、２画素以上離れた信号からの補正でも同色の補正であれば欠陥は目立たない。

【００１１】本発明の第２の態様では、それぞれ所定の色の色フィルタを前面に配置した複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置において、前記カラー撮像素子の欠陥画素の位置を示す信号を出力する欠陥データ発生装置と、前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、前記輝度信号用欠陥補正装置からの信号を受け入れて前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号を前記欠陥画素近傍の同じ色の画素の信号もしくは同じ色の複数の画素の信号の平均で置き換えて再補正を行なうことにより欠陥補正された色信号を得るための色信号用欠陥補正装置とを設ける。

【００１２】このような構成では、輝度信号用欠陥補正装置は欠陥データ発生装置からの信号に基づき欠陥画素の信号を隣接する画素の信号で置き換え補正する。従って、輝度信号の高解像度成分が失われることは少なく輝度の欠陥も目立たなくなる。また、色信号用欠陥補正装置は、カラー撮像素子からの信号を前記輝度信号用欠陥補正装置によって補正した後に、欠陥データ発生装置からの信号に基づき再補正を行なう。この再補正は欠陥画素近傍の同じ色の画素の信号を使用して行われるから同色の補正になり色信号の欠陥としても目立たない。従って、前記輝度信号用欠陥補正装置によって得られる欠陥補正された信号および前記色信号用欠陥補正装置によっ

て再補正された色信号に基づき適切に欠陥補正されかつ欠陥が目立たないカラー映像信号を生成することが可能になる。

【００１３】この場合、前記カラー撮像素子からの信号に対してホワイトバランス処理を行った後に前記輝度信号用欠陥補正装置にて欠陥補正処理を行なうと好都合である。

【００１４】ホワイトバランス処理を行なった後に輝度信号用欠陥補正装置にて輝度信号用の欠陥補正を行なうことにより装置構成を簡略化し適切な補正を行なうことができる。これは、予め、ホワイトバランス処理が行なわれて、各色の色信号のレベルが調整されていれば、欠陥画素の色にかかわらず隣接画素の信号によって欠陥画素の信号と単純に置き換えを行なうのみでよく、レベル調整などを必要としないため装置構成が簡略化される。

【００１５】また、前記輝度信号用欠陥補正装置は、例えば、欠陥画素の信号を直前の画素の信号と置き換えることができる。

【００１６】あるいは、前記輝度信号用欠陥補正装置は欠陥画素の信号を直前および直後の画素の信号の平均信号で置き換えることもできる。

【００１７】輝度信号用の欠陥補正を行なう場合、欠陥画素の信号を直前の画素の信号、あるいは直前および直後の画素の信号の平均信号で置き換えることにより、輝度信号の高解像度成分が失われることが少なくなり輝度の欠陥としても目立たなくなる。

【００１８】また、前記色信号用欠陥補正装置は、例えば、欠陥画素の信号を最も近い同色の前後の画素の信号の平均信号、または同色の斜め上下前後４か所の信号の平均信号で置き換えることができる。

【００１９】色信号については、欠陥画素の信号を最も近い同色の前後の画素の信号の平均、または同色の斜め上下前後４か所の信号の平均などで置き換えることにより、欠陥画素と同じ色で欠陥補正が行われ、色の欠陥が目立たなくなる。また、色信号は解像度が低いためたとえ隣接する画素でなくても同じ色の画素の信号を利用して補正を行なった方が欠陥が目立たなくなる。

【００２０】本発明の第３の態様では、赤色と緑色の画素が交互に配置された第１の水平行と、緑色と青色の画素が交互にかつ緑色の画素は前記第１の水平行の緑色の画素の間の位置に対応して配置された第２の水平行とが交互に反復するよう配置された複数の画素を備えたカラー撮像素子における欠陥画素の信号を補正するカラー撮像素子の欠陥補正装置において、前記カラー撮像素子の欠陥画素の位置を示す信号を出力する欠陥データ発生装置と、前記欠陥データ発生装置からの信号に基づき前記欠陥画素の信号をその画素の色にかかわらず隣接する画素の信号もしくは隣接する複数の画素の信号の平均で置き換えることで欠陥補正された輝度信号を得るための輝度信号用欠陥補正装置と、前記輝度信号用欠陥補正装置からの信号を受け入れて前記欠陥データ発生装置からの信号に基づき欠陥補正された色信号を得るための色信号用欠陥補正装置であって、注目水平行の両側の水平行では、欠陥画素の信号を水平前後２画素離れた画素の信号の平均で置き換え、注目水平行では、欠陥画素が赤色または青色の場合は該欠陥画素の信号を水平前後２画素離れた画素の信号の平均で置き換え、欠陥画素が緑色の場合は該欠陥画素の信号を斜め上下前後４か所の画素の信号の平均で置き換えて再補正を行なうことにより、欠陥補正された色信号を得るための前記色信号用欠陥補正装置と、前記欠陥補正された注目水平行および該注目水平行の両側の水平行の補正された色信号を使用して各原色の色信号を出力する色分離回路とを設ける。

【００２１】上記構成では、カラー撮像素子はいわゆる、緑市松、赤青線順次と称される画素配列を有するものである。このような場合、輝度信号用欠陥補正装置は隣接する画素の信号または隣接する複数の画素の信号の平均で輝度信号の欠陥補正を行なうことにより、輝度信号の高解像度成分が失われることが少なく欠陥が目立たないようにすることができる。また、色信号については、注目水平行その両側の水平行の３つの水平行に対して欠陥補正を行なう注目水平行の両側の水平行では、欠陥画素の信号を水平前後２画素離れた画素の信号の平均で置き換えることによりすべての色について同色の信号で欠陥補正を行なうことができる。また、注目水平行では、欠陥画素が赤色または青色の場合は水平前後２画素離れた画素の信号の平均で置き換えることにより同色の信号で補正を行なうことができる。また、欠陥画素が緑色の場合は斜め上下前後４か所の同色の画素の信号の平均で置き換えることにより欠陥が目立たない補正を行なうことができる。このようにして欠陥補正された３つの水平行からの色信号を利用して色分離回路によりすべての原色の色信号を生成することができる。

【００２２】この場合、前記カラー撮像素子からの信号に対してホワイトバランス処理を行った後に前記輝度信号用欠陥補正装置にて欠陥補正処理を行なうと好都合である。

【００２３】ホワイトバランス処理を行なった後に輝度信号用欠陥補正装置にて輝度信号用の欠陥補正を行なうことにより装置構成を簡略化し適切な補正を行なうことができる。これは、予め、ホワイトバランス処理が行なわれて、各色の色信号のレベルが調整されていれば、欠陥画素の色に関わらず隣接画素の信号によって欠陥画素の信号と単純に置き換えを行なうのみでよく、レベル調整などを必要としないため装置構成が簡略化される。

【００２４】

【発明の実施の形態】以下、図面を参照して本発明に係わるカラー撮像素子の欠陥補正装置につき説明する。図１は、本発明の１実施形態に係わる欠陥補正装置を含む単板カラーカメラの信号処理回路を示す。図１の装置で

は、前記図７に示される配列の原色フィルタを備えた撮像素子を使用する場合の構成を示している。

【００２５】図１のカラー撮像素子の欠陥補正装置は、図示しない撮像素子からの信号を増幅する増幅器１と、増幅器１の信号をデジタル信号に変換するＡ／Ｄ変換器２と、Ａ／Ｄ変換器２から供給されるデジタル映像信号に白バランス処理を行なう白バランス回路３と、白バランス回路３に白バランス処理に必要なデータを供給する白バランスデータ発生回路４を備えている。

【００２６】図１の装置はまた、白バランス回路３の出力に対し輝度信号用の欠陥補正を行なう輝度信号用欠陥補正回路５と、輝度信号用欠陥補正回路５から出力される欠陥補正された信号にγ補正を行なうγ補正回路７と、γ補正回路７の出力信号をそれぞれ１水平期間づつ遅延させる１Ｈ遅延回路８，９と、輝度信号用欠陥補正回路５に撮像素子の欠陥補正のための制御信号を供給する欠陥データ発生回路６と、欠陥データ発生回路６に欠陥位置を示す情報を提供する欠陥位置指定用の欠陥ＲＯＭ１６を備えている。

【００２７】さらに、図１の装置は、欠陥データ発生回路６からの信号に基づき色信号の欠陥補正を行なう色信号用欠陥補正回路１１と、色信号用欠陥補正回路１１によって欠陥補正された３つの水平ラインの信号から色信号を生成する色分離回路またはカラーデコーダ１２と、カラーデコーダ１２の出力から輝度信号Ｙｌと色素信号Ｃｒ，Ｃｂを生成するエンコーダ１３を備えている。

【００２８】さらに、図１の装置は、輝度信号用欠陥補正回路５によって欠陥補正された信号に基づき、水平方向の輪郭信号Ｙｈと垂直方向の輪郭補正信号Ｙｈｌを生成する輝度信号処理回路１０と、高解像度の輝度信号（Ｙｏｕｔ）を生成する輝度信号解像度補正回路１４と、装置各部に必要なクロックパルスや制御パルス、同期パルスなどを供給するシステムパルス発生回路１５とを備えている。

【００２９】図１の装置においては、駆動回路１８によって駆動される撮像素子１７からの信号は図７に示される画素配列の走査に従って、異なる色の信号が点順次で出力される。これら各色の信号はアナログ映像信号であり、増幅器１によって増幅され、図示しないクランプ回路によって直流レベルを調整された後Ａ／Ｄ変換器２に入力される。Ａ／Ｄ変換器２においては、各画素ごとに標本化され、かつＡ／Ｄ変換されて、デジタル映像信号に変換される。

【００３０】このデジタル映像信号は画素ごとに順次色が異なる信号であり、白バランス回路３において、画素ごとの色に合わせて白バランスデータ発生回路４で発生された白バランスデータをかけ算されて、白を撮像した時にたとえばＲ，Ｂの信号がＧの信号と同じ大きさになるように調整される。

【００３１】輝度信号用欠陥補正回路５は、白バランス回路３の出力を欠陥補正制御信号発生回路６から供給される制御信号に従って、欠陥画素の色にかかわらず隣接画素によって輝度信号用の点欠陥補正を行なう。

【００３２】欠陥補正制御信号発生回路６は欠陥位置指定用メモリ１６に格納されているデータに従って欠陥補正の制御信号を輝度信号用欠陥補正回路５と色信号用欠陥補正回路１１に供給する。欠陥位置指定用メモリ１６ははたとえばプログラマブルＲＯＭであって個々の撮像素子固有の点欠陥の位置をカメラの製造者が調べ、図示しない装置で予め記憶させてある。

【００３３】γ補正回路７は輝度信号用欠陥補正回路５からの欠陥補正された信号に対し周知のγ補正を行なう。この場合、予め白バランス回路３で白バランスを取ってあるので各色共通に１つの回路、たとえばＲＯＭテーブル、で済ますことができる。

【００３４】γ補正回路７の出力信号は１Ｈ遅延回路８，９に順次入力される。１Ｈ遅延回路８，９は走査画素の垂直方向の信号処理を行なうためにそれぞれ１水平走査期間信号を遅延させるものである。遅延しない信号をＤＬ０、１Ｈ遅延回路８を通って１水平期間遅延した信号をＤＬ１、ＤＬ１がもう１度１Ｈ遅延回路９を通って２水平期間遅延した信号をＤＬ２とする。

【００３５】次に、輝度信号処理回路１０において、前記信号ＤＬ０，ＤＬ１，ＤＬ２が演算されて水平方向の輪郭信号Ｙｈと垂直方向の輪郭補正信号Ｙｈｌを作成する。このように輝度信号の高解像度成分ＹｈとＹｈｌは欠陥画素に隣接する画素からの信号で欠陥補正された信号で作られるので輝度の欠陥として目立たない。

【００３６】色信号用欠陥補正回路１１は前記信号ＤＬ０，ＤＬ１，ＤＬ２を使って、後に詳細に説明するよう欠陥補正制御信号発生回路６からの制御信号を受けて、同色の信号からの補完で欠陥補正を行なう。

【００３７】このようにして色信号用欠陥補正回路１１で傷補正されたＤＬ０，ＤＬ１，ＤＬ２の各信号は、カラーデコーダ１２において、色分離され赤（Ｒ）緑（Ｇ）青（Ｂ）の各色信号が作成される。

【００３８】さらに、エンコーダ回路１３では、当業者によく知られたマトリックス回路を使用して輝度信号（Ｙｌ）と２つの色差信号（Ｃｒ、Ｃｂ）を賛成する。また、輝度信号解像度補正回路１４は、エンコーダ回路１３で作成された輝度信号Ｙｌと輝度信号処理回路１０からの水平高解像度成分Ｙｈと垂直輪郭補正信号Ｙｈｌを使って処理し、高解像度輝度信号Ｙｏｕｔを作成する。

【００３９】以上のようにして生成された輝度信号Ｙｏｕｔと色差信号Ｃｒ，Ｃｂはたとえば図示しない記録装置やモニタ装置で記録されたり、あるいは映像表示される。

【００４０】図２は輝度信号用欠陥補正回路５の具体的な構成例を示し、１画素分の遅延回路３１および切り替

え回路３２を備えている。出力映像信号ＯＵＴは点欠陥の位置を示す輝度欠陥信号ＹＣＯＭＰが入ると切り替え回路３２で入力映像信号ＩＮから遅延回路３１を通った信号に切り替えられ、欠陥画素が走査の順序に従って左どなりの画素の信号と置き換えられて点欠陥が補正される。

【００４１】図３は輝度信号処理回路１０の具体的な構成例を示す。同図において、４１，４２は足し算回路であってそれぞれ２つの入力信号を足し算した後、１／２にする。４３，４４はサンプリング回路であってそれぞれＧ＿Ｓ／Ｈ１、Ｇ＿Ｓ／Ｈ２のはサンプリング信号で入力信号のサンプリングを行なう。４５は引き算回路である。４６は１画素分の遅延回路である。

【００４２】図３の回路においては、前記信号ＤＬ０，ＤＬ２が足し算回路４１で足し算される。この足し算された信号は前記信号ＤＬ１と足し算回路４２で足し算され、位相を合わせるため遅延回路４６で１画素分遅らせて高解像度輝度信号Ｙｈとして出力される。すなわち、高解像度輝度信号Ｙｈは次のように表される。

【数１】Ｙｈ＝（ＤＬ０＋２＊ＤＬ１＋ＤＬ２）／４

このようにすることにより、水平方向に高解像度であるが、垂直方向には解像度の低い、各色を平均した輝度信号が得られる。なお、この輝度信号は正規の色混合率の輝度信号とは違うがこのような構成にすることにより、後述の垂直輪郭補正回路で４次以上の高次のフィルター処理を施すことができ、色信号の高調波成分が抑えられ、高解像度の輝度信号の合成が可能になる。水平方向の高次のフィルタ処理はよく知られた比較的簡単な回路で実現できる。

【００４３】信号ＤＬ０とＤＬ２を足し算して得られた信号はまた、対応水平ラインの緑の信号の位相に合わせてサンプリング回路４４でサンプリングされる。また、ＤＬ１の信号は対応水平ライン緑の信号の位相に合わせてサンプリング回路４３でサンプリングされ、サンプリング回路４４の出力と引き算回路４５により図示された符号で引き算され、輝度信号Ｙｈｌを出力する。なぜなら、図７から分かるように信号ＤＬ０，ＤＬ１，ＤＬ２から作成できる垂直輪郭成分は、他に垂直方向の高次のフィルタ処理をして平均処理をしない場合、緑成分からしか抽出できず、他の色成分を使用すると色誤差を大きくさせるからである。また、垂直方向の高次のフィルタ処理は１Ｈ遅延回路を追加次数分多くする必要があり、回路規模を大きくする。

【００４４】図４は輝度信号解像度補正回路１４の具体的構成例を示す。同図において、５１，５４は足し算回路、５２はローパスフィルタ、５３は水平輪郭補正回路である。

【００４５】図４の回路においては、まず、エンコーダ回路１３の輝度出力Ｙｌに輝度信号処理回路１０の垂直輪郭補正信号Ｙｈｌが足し算回路５１により足し算され、この足し算した信号をローパスフィルタ５２を通すことによって垂直解像度が高く、水平解像度の低い、正規の輝度混合率のかかった輝度信号が得られる。ローパスフィルタ５２を通った信号と輝度信号処理回路１０の出力の高解像度輝度信号Ｙｈから水平輪郭補正回路５３によって抽出された水平輪郭補正信号を足し算回路５４で足し算することにより、垂直、水平共に高解像度で低解像度成分は正規の色混合率の輝度信号がＹｏｕｔが得られる。このような処理で点欠陥は広い範囲に誤差伝搬しないので輝度信号の点欠陥はきれいに補正される。

【００４６】図５は色信号用欠陥補正回路１１の具体的構成例を示す。同図において、６１ａ～６１ｌは遅延回路であってそれぞれ１画素クロック分の信号遅延を行ない、同時に遅延回路の数だけ離れた画素の信号を処理できるようにするものである。６２ａ～６２ｆは平均足し算回路であってそれぞれ入力される２信号の足し算とその平均処理（ビットシフトにより１／２にする処理）を行なう。また、６３，６４，６５，６６は信号切り替え回路であって、それぞれ切り替え信号ＤＬ０ＣＯＭＰ，ＤＬ２ＣＯＭＰ，ＤＬ１ＣＯＭＰ，ＧＣＯＭＰの信号に従って信号を切り替える。

【００４７】図５の回路においては、信号ＤＬ０と信号ＤＬ２の画素列に対応する信号に対しての欠陥補正は、どの色であっても欠陥画素と同じ色の水平前後の２画素離れた信号の平均をそれぞれ平均足し算回路６２ｂと同じく６２ｅでそれぞれの補正信号として求めることによって行なう。これらの補正信号はそれぞれの欠陥信号位置に同期した切り替え信号ＤＬ０ＣＯＭＰ，ＤＬ２ＣＯＭＰに従って、それぞれ切り替え回路６３，６４で欠陥画素の信号と切り替えることで欠陥補正を行なう。たとえば、信号ＤＬ０とＤＬ２が赤信号（Ｒ）と緑信号（Ｇ）が交互に出力される画素列の信号であったら、欠陥画素と同じ画素列の同じ色の２画素前後した信号のＲまたはＧと置き換えられる。もし、信号ＤＬ０とＤＬ２が青信号（Ｂ）とＧとが交互に出力される信号であっても、同様である。

【００４８】信号ＤＬ１の画素列に対応する信号に対しての欠陥補正は、欠陥画素の信号がＧ信号の場合と、ＲまたはＢ信号の場合で補正方法を異ならせている。

【００４９】欠陥画素がＲまたはＢ信号の場合、前述の信号ＤＬ０や信号ＤＬ２の画素列に対応する信号の欠陥補正と同様に欠陥画素と同じ色の水平前後２画素離れた信号の平均を平均足し算回路６２ｃで求め、切り替え回路６５で切り替え信号ＤＬ１ＣＯＭＰに従って欠陥画素を置き換えることで欠陥補正を行なう。

【００５０】欠陥画素がＧ信号の場合は同じ色の最近接画素を斜め上下前後１画素離れた４画素であり、それらの平均を平均足し算回路６２ａ、６２ｄ、６２ｆで求めて、それを切り替え回路６６で切り替え信号ＧＣＯＭＰに従って欠陥画素と切り替えることで欠陥補正を行なっ

ている。

【００５１】図６は色信号分離回路１２の具体的構成例を示し、色信号用欠陥補正回路１１で欠陥補正された信号ＤＬ０′，ＤＬ１′，ＤＬ２′を使って色分離する。７６は平均足し算回路であってＤＬ０′とＤＬ２′を足し算して平均する回路である。７１，７２，７３はサンプリング回路であってそれぞれ、サンプリング制御信号ＳＨ０，ＳＨ１，ＳＨ０でサンプリングされる。７４，７５はライン切り替え回路である。

【００５２】図６の回路においては、Ｇ信号は信号ＤＬ１′より、サンプリング回路７３で制御信号ＳＨ０により、その画素の位相に合わせてサンプリングされる。Ｒ信号とＢ信号は交互に出てくるラインが変わるので、出力されないラインでは前後のラインで補完する処理がなされる。信号ＤＬ０′とＤＬ２′の平均を平均足し算回路７６で求め、対応水平ラインのＲまたはＢ信号をサンプリング回路７１でサンプリングする。サンプリング回路７１の出力と、信号ＤＬ１′をサンプリング回路７２でサンプリングしたＢまたはＲ信号とをライン切り替え回路７４，７５およびライン切り替え信号ＬＩＮＥを使用して切り替えてそれぞれ、Ｒ信号およびＢ信号とする。この時、使用する信号はすべて欠陥補正されているので、欠陥が目立つことはない。以上のようにして得られた欠陥補正された各色信号Ｒ，Ｇ，Ｂは、周知のエンコーダ１３に入力されて２つの色差信号Ｃｒ，Ｃｂおよび輝度信号Ｙ１が作成される。

【００５３】

【発明の効果】以上のように、本発明によれば、輝度信号と色信号とをそれぞれ別の最適の方法で欠陥補正を行なうことができるから、比較的簡単な装置構成で輝度信号の高解像度成分が失われることがなくかつより欠陥が目立たない欠陥補正装置を実現することができる。

【００５４】特に、本発明では、輝度信号については欠陥画素の信号をその画素の色にかかわらず隣接する画素で補正し、色信号については同じ色の近傍の画素の信号で補正するから、輝度信号の高解像度成分が失われることがなく輝度の欠陥が目立たなくなる。また、色信号についても同色の信号で補正するから色の相違による欠陥が目立つことはない。

【００５５】さらに、本発明では、カラー撮像素子から＊の出力信号に対し予め画素の色にかかわらず隣接する画素の信号で輝度信号用の欠陥補正を行ない、その後色信号を生成するための信号については輝度信号用の補正が行われた信号を同色の近傍の画素の信号で最補正するよう構成している。このため、既存の回路をも適切に活用しつつ新たな欠陥補正回路を組み込むことができ、装置構成も簡略化することができる。

【図面の簡単な説明】

【図１】本発明の１実施形態に係わるカラー撮像素子の欠陥補正装置を含む映像信号処理回路の構成を示すブロック図である。

【図２】図１の回路における輝度信号用欠陥補正回路の概略の構成を示すブロック回路図である。

【図３】図１の装置における輝度信号処理回路の構成を示すブロック回路図である。

【図４】図１の回路における輝度信号解像度補正回路の構成を示すブロック回路図である。

【図５】図１の回路における色信号用欠陥補正回路の構成を示すブロック回路図である。

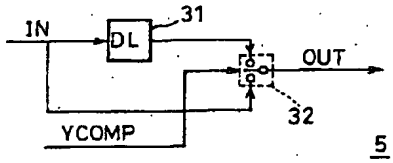
【図６】図１の回路における色分離回路の詳細な構成を示すブロック回路図である。

【図７】本発明の１実施形態に係わる欠陥補正装置を使用するカラー撮像素子の画素配列を示す部分的平面図である。

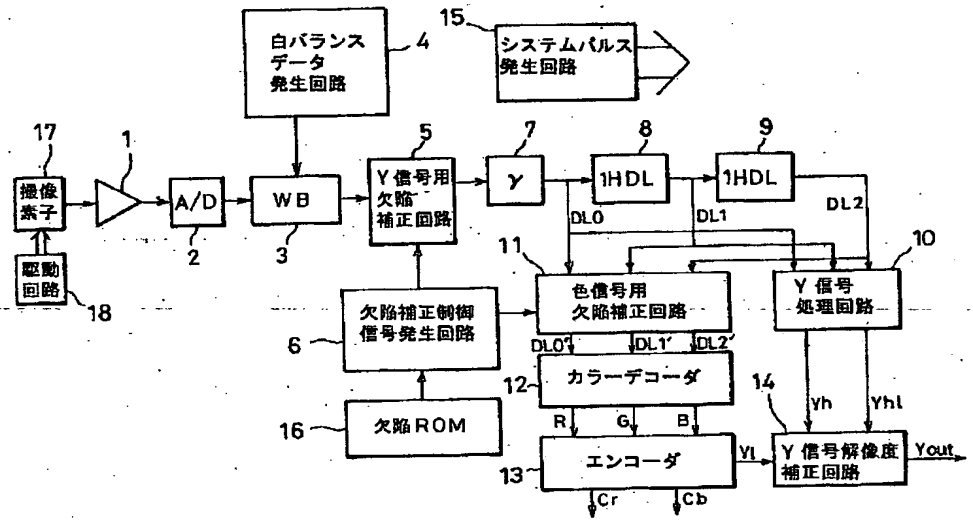
【符号の説明】

１　増幅器
２　Ａ／Ｄ変換回路
３　白バランス回路
４　白バランスデータ発生回路
５　輝度信号用欠陥補正回路
６　欠陥補正制御信号発生回路
７　γ補正回路
８，９　１Ｈ遅延回路
１０　輝度信号処理回路
１１　色信号用欠陥補正回路
１２　色分離回路またはカラーデコーダ
１３　エンコーダ回路
１４　輝度信号解像度補正回路
１５　システムパルス発生回路
１６　欠陥位置指定用メモリ

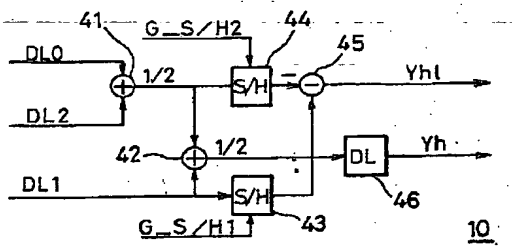
【図２】



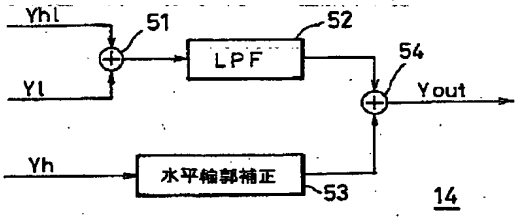
【図１】


白バランス
データ
発生回路
4
15
システムパルス
発生回路
17
撮像
素子
1
A/D
2
WB
3
5
Y信号用
欠陥
補正回路
7
γ
8
1HDL
9
1HDL
DL2
DL0
DL1
11
10
色信号用
欠陥補正回路
Y信号
処理回路
駆動
回路
18
欠陥補正制御
信号発生回路
6
DL0'
DL1'
DL2'
12
カラーデコーダ
14
Yh
Yhl
16
欠陥ROM
R
G
B
13
エンコーダ
Yl
Y信号解像度
補正回路
Yout
Cr
Cb

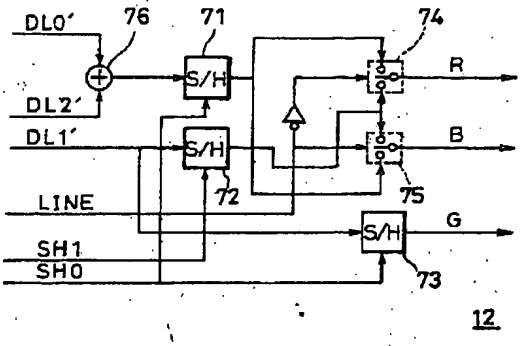
【図３】


41
G_S/H2
44
45
DL0
1/2
S/H
Yhl
DL2
42
1/2
DL
Yh
DL1
S/H
46
G_S/H1
43
10

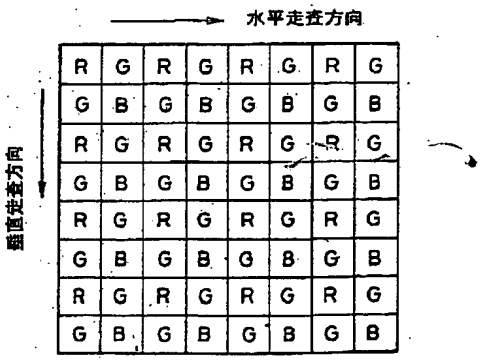
【図４】


Yhl
51
52
LPF
54
Yout
Yl
Yh
水平輪郭補正
53
14

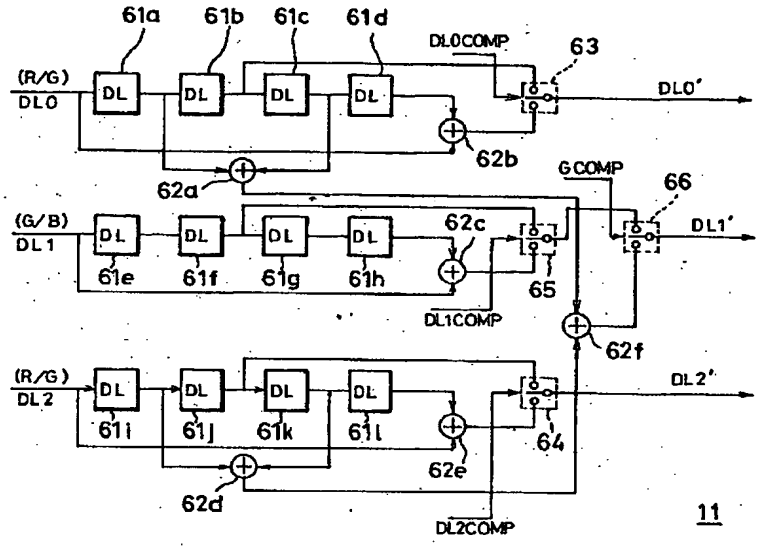
【図６】


DL0'
76
71
74
S/H
R
DL2'
DL1'
S/H
B
LINE
72
75
S/H
G
SH1
SH0
73
12

【図７】


水平走査方向
垂直走査方向
R G R G R G R G
G B G B G B G B
R G R G R G R G
G B G B G B G B
R G R G R G R G
G B G B G B G B
R G R G R G R G
G B G B G B G B

【図５】


61a
61b
61c
61d
DL0COMP
63
(R/G)
DL0
DL
DL0'
62b
62a
GCOMP
66
(G/B)
DL1
62c
DL1'
61e
61f
61g
61h
65
DL1COMP
62f
(R/G)
DL2
DL2'
61i
61j
61k
61l
64
62e
62d
DL2COMP
11

PATENT ABSTRACTS OF JAPAN

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(21)Application number : 08-289143 (71)Applicant : NIKON CORP

(22)Date of filing : 11.10.1996 (72)Inventor : JIYUEN MASAHIRO

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(54) FAULT CORRECTING DEVICE OF COLOR IMAGE PICKUP DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To correct faults in an inconspicuous way without losing high resolution components of a luminance signal in a fault correcting device of an image pickup device.

SOLUTION: This device corrects a signal of fault pixels for a single CCD color image pickup device that has plural pixels where color filters of each prescribed color are arranged in an entire area. The device is provided with fault data generating devices 6 and 16 which output a signal that shows the position of a fault pixel, a luminance signal fault correcting device 5 which corrects a signal of a fault pixel by replacing a signal of adjacent pixels or an average of its adjacent signals despite the color of the fault pixel, and a color signal fault correcting device 11 which accepts a signal from the device 5 and corrects a color signal by performing the optimum correction by replacing the signal of a fault pixel with a signal of its adjacent pixel of the same color or an average of signals of plural pixels of the same color.

LEGAL STATUS [Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] The defective compensator for luminance signals for acquiring the luminance signal by which is the defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more pixels which have arranged the color filter of a predetermined color in the front face, respectively, and defective amendment was carried out, and said defective compensator for luminance signals are the defective compensator of the color image sensor characterized by to provide the defective compensator for chrominance signals for being prepared separately and acquiring the chrominance signal by which defective amendment was carried out.

[Claim 2] It is the defective compensator of the color image sensor according to claim 1 characterized by performing said defective compensator for luminance signals by replacing the signal of a defect pixel by the average of the signal of the pixel which adjoins irrespective of the color of the pixel, or the signal of two or more adjoining pixels, and performing said defective compensator for chrominance signals by replacing by the average of the signal of the pixel of the same color near the defect pixel, or the signal of two or more pixels of the same

color.

[Claim 3] It is the defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more pixels which have arranged the color filter of a predetermined color in the front face, respectively. The defective data generator which outputs the signal which shows the location of the defect pixel of said color image sensor, The defective compensator for luminance signals for acquiring the luminance signal by which defective amendment was carried out by replacing the signal of said defect pixel based on the signal from said defective data generator by the average of the signal of the pixel which adjoins irrespective of the color of the pixel, or the signal of two or more adjoining pixels, By accepting the signal from said defective compensator for luminance signals, replacing the signal of said defect pixel based on the signal from said defective data generator by the average of the signal of the pixel of the same color near [said] the defect pixel, or the signal of two or more pixels of the same color, and performing re-amendment The defective compensator of the color image sensor characterized by providing the defective compensator for chrominance signals for acquiring the chrominance signal by which defective amendment was carried out.

[Claim 4] The defective compensator of the color image sensor according to

claim 3 characterized by performing defective amendment processing with said defective compensator for luminance signals after performing white balance processing to the signal from said color image sensor.

[Claim 5] Said defective compensator for luminance signals is a defective compensator of the color image sensor according to claim 3 characterized by replacing the signal of a defect pixel with the signal of the last pixel.

[Claim 6] Said defective compensator for luminance signals is a defective compensator of the color image sensor according to claim 3 characterized by replacing the signal of a defect pixel by the average signal of the signal of the pixel of just before and an immediately after.

[Claim 7] Said defective compensator for chrominance signals is a defective compensator of a color image sensor given in any 1 term of claims 3-6 characterized by replacing the signal of a defect pixel by the average signal of four signals before and after the average signal of the signal of the pixel before and behind the nearest same color, or the slanting upper and lower sides of the same color.

[Claim 8] Red and the 1st water parallel by which the green pixel has been arranged by turns, green and a blue pixel -- alternation -- and a green pixel -- said 1st water -- so that the 2nd water parallel arranged corresponding to the location between parallel green pixels may repeat by turns The defective data

generator which is a defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more arranged pixels, and outputs the signal which shows the location of the defect pixel of said color image sensor, The defective compensator for luminance signals for acquiring the luminance signal by which defective amendment was carried out by replacing the signal of said defect pixel based on the signal from said defective data generator by the average of the signal of the pixel which adjoins irrespective of the color of the pixel, or the signal of two or more adjoining pixels, It is a defective compensator for chrominance signals for acquiring the chrominance signal by which accepted the signal from said defective compensator for luminance signals, and defective amendment was carried out based on the signal from said defective data generator. attention water -- water parallel of parallel both sides -- if -- the average of the signal of a pixel which left 2 pixels of signals of a defect pixel before and after the horizontal -- replacing -- attention water parallel -- if -- A defect pixel replaces the signal of this defect pixel by the average of the signal of a pixel which left 2 pixels before and after level, red or when blue. By replacing the signal of this defect pixel by the average of the signal of four pixels before and after the slanting upper and lower sides, and performing re-amendment, when a defect pixel is green Said defective compensator for chrominance signals for acquiring the chrominance

signal by which defective amendment was carried out, and the color separation circuit which outputs the chrominance signal of each primary color using the chrominance signal with which water parallel of the both sides of said attention water parallel by which defective amendment was carried out, and these attention water parallel were amended, The defective compensator of the color image sensor characterized by providing.

[Claim 9] The defective compensator of the color image sensor according to claim 8 characterized by performing defective amendment processing with said defective compensator for luminance signals after performing white balance processing to the signal from said color image sensor.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the technique which amends so that a defect may not be conspicuous, without losing the high resolution component of a luminance signal, when amending the signal of the defect pixel of a color image sensor about the defective compensator of a color

image sensor.

[0002]

[Description of the Prior Art] The defect of a pixel may produce a solid state image sensor by mixing of the foreign matter in the manufacture course, and a blemish and others. There are the flake defect and sunspot defect which output the signal of a white level or black level, for example to the level of incident light without relation as a defect of such a pixel. He amends by replacing the signal of a defect pixel with the complement value conventionally generated based on the signal from the pixel which adjoins a defect pixel, or a surrounding pixel, and was trying for the effect of a defect pixel not to arise in an image pick-up image about the defect of a pixel in which the defect of such a pixel was inner-isolated.

[0003] Moreover, in the veneer color image sensor which arranges the color filter of the shape of the shape of a mosaic, and a stripe corresponding to a pixel, and obtains a color picture on the optical plane of incidence of an image sensor of one sheet, since it was the pixel of a different color, the pixel which carries out the nearest neighbors was usually performing amendment of a defect pixel by complementing with the pixel of the same color as this defect pixel by the nearest pixel.

[0004] for example, green [, for example] in a green (G) check as shown in drawing 7 , and the filter array called (Red R) (blue B) line sequential -- it was

carried out by replacing for complementing the pixel of (G) by the average of the 4-pixel signal of the same color before and behind the slanting upper and lower sides, or the signal of the same color in front of 2 pixels of horizontal directions. Moreover, the pixel of blue (B) and red (R) was performing defective amendment by replacing by the average of the signal of four pixels of the same color which separated 2 pixels of four directions, or the average of the signal of two pixels of the same color before and after leaving 2 pixels horizontally. And the luminance signal, the required color-difference signal, etc. were created with the encoder from the chrominance signal of each color by which defective amendment was carried out by doing in this way.

[0005]

[Problem(s) to be Solved by the Invention] However, since it complemented with defective amendment upwards about a color image sensor which was described by the signal of the pixel which the same color as complementing a defect pixel left, there was un-arranging [that the high resolution component of the luminance signal generated from the luminance-signal component contained in the pixel of each color will be lost]. for this reason -- for example, even if it was a photographic subject without a color, when a defect hit that profile section, the big level difference was produced in the luminance signal, and the phenomenon in which a defect will be conspicuous was caused.

[0006] This invention can be made to perform defective amendment appropriately in the defective compensator of a color image sensor in view of the trouble in such a conventional example, without losing the high resolution component of a luminance signal, and is to enable it to generate the color image pick-up signal with which a defect is not more conspicuous.

[0007]

[Means for Solving the Problem] In the 1st **** of this invention, the defective compensator for chrominance signals for the defective compensator for luminance signals for acquiring the luminance signal by which defective amendment was carried out, and said defective compensator for luminance signals being formed separately, and acquiring the chrominance signal by which defective amendment was carried out is formed in the defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more pixels which have arranged the color filter of a predetermined color in the front face, respectively.

[0008] That is, the defective compensator for luminance signals performs defective amendment for signal processing which creates the luminance signal by which defective amendment was carried out, and defective amendment doubled with the chrominance signal with the defective compensator for chrominance signals formed apart from this is carried out to it. By this, the

optimal amendment approach for a luminance signal and each chrominance signal can be used, and more suitable and amendment in which a defect is not conspicuous can be performed.

[0009] In this case, said defective compensator for luminance signals can perform the signal of a defect pixel by replacing by the average of the signal of the pixel which adjoins irrespective of the color of that pixel, or the signal of two or more adjoining pixels, and said defective compensator for chrominance signals can be performed by replacing by the average of the signal of the pixel of the same color near the defect pixel, or the signal of two or more pixels of the same color.

[0010] More high resolution components of a luminance signal are saved, that a high resolution component is lost decreases, and it stops being conspicuous also as a defect of brightness irrespective of the color of a defect pixel about a luminance signal by [adjoining] acquiring a defective amendment signal, for example from a pixel on the left, and permuting the signal of a defect pixel. Moreover, a chrominance signal becomes without a color changing with amendments, since a defective amendment signal is acquired from a defect pixel and the pixel which the same color approaches, a defect pixel is permuted and signal processing is performed, and suitable amendment is performed. Moreover, resolution of a chrominance signal is low from the first, and a defect is

not conspicuous if the amendment from the signal which left 2 pixels or more is also amendment of the same color.

[0011] In the defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more pixels which have arranged the color filter of a predetermined color in the front face, respectively in the 2nd **** of this invention The defective data generator which outputs the signal which shows the location of the defect pixel of said color image sensor, The defective compensator for luminance signals for acquiring the luminance signal by which defective amendment was carried out by replacing the signal of said defect pixel based on the signal from said defective data generator by the average of the signal of the pixel which adjoins irrespective of the color of the pixel, or the signal of two or more adjoining pixels, By accepting the signal from said defective compensator for luminance signals, replacing the signal of said defect pixel based on the signal from said defective data generator by the average of the signal of the pixel of the same color near [said] the defect pixel, or the signal of two or more pixels of the same color, and performing re-amendment The defective compensator for chrominance signals for acquiring the chrominance signal by which defective amendment was carried out is formed.

[0012] With such a configuration, the defective compensator for luminance

signals replaces and amends the signal of a defect pixel with the signal of the adjoining pixel based on the signal from a defective data generator. It is rare to lose the high resolution component of a luminance signal, and the defect of brightness also stops therefore, being conspicuous. Moreover, the defective compensator for chrominance signals performs re-amendment based on the signal from a defective data generator, after amending the signal from a color image sensor with said defective compensator for luminance signals. Since this re-amendment is performed using the signal of the pixel of the same color near the defect pixel, it turns into amendment of the same color and is not conspicuous as a defect of a chrominance signal. Therefore, it becomes possible to generate the color video signal with which defective amendment is appropriately carried out based on the chrominance signal re-amended by the signal which is acquired by said defective compensator for luminance signals, and by which defective amendment was carried out, and the defective compensator for said chrominance signals and with which a defect is not conspicuous.

[0013] In this case, it is convenient, if said defective compensator for luminance signals performs defective amendment processing after performing white balance processing to the signal from said color image sensor.

[0014] After performing white balance processing, by performing defective

amendment for luminance signals with the defective compensator for luminance signals, an equipment configuration can be simplified and suitable amendment can be performed. If, as for this, the level of the chrominance signal of each color is beforehand adjusted by performing white balance processing, since it does not only need level adjustment etc. that you may replace with the signal of a defect pixel simply with the signal of a contiguity pixel irrespective of the color of a defect pixel, an equipment configuration will be simplified.

[0015] Moreover, said defective compensator for luminance signals can replace the signal of a defect pixel with the signal of the last pixel.

[0016] Or said defective compensator for luminance signals can also replace the signal of a defect pixel by the average signal of the signal of the pixel of just before and an immediately after.

[0017] When performing defective amendment for luminance signals, that the high resolution component of a luminance signal is lost decreases, and it stops being conspicuous also as a defect of brightness by replacing the signal of a defect pixel by the average signal of the signal of the pixel of the signal of the last pixel or just before, and an immediately after.

[0018] Moreover, said defective compensator for chrominance signals can replace the signal of a defect pixel by the average signal of four signals before and after the average signal of the signal of the pixel before and behind the

nearest same color, or the slanting upper and lower sides of the same color.

[0019] Defective amendment is performed in the same color as a defect pixel, and the defect of a color stops being conspicuous about a chrominance signal by replacing the signal of a defect pixel by the average of four signals etc. before and after the average of the signal of the pixel before and behind the nearest same color, or the slanting upper and lower sides of the same color. Since resolution of a chrominance signal is low, even if it is not the pixel which adjoins even if, a defect stops moreover, the direction which amended using the signal of the pixel of the same color being conspicuous.

[0020] The 1st water parallel by which as green the pixel in the 3rd **** of this invention as red has been arranged by turns, green and a blue pixel -- alternation -- and a green pixel -- said 1st water -- so that the 2nd water parallel arranged corresponding to the location between parallel green pixels may repeat by turns In the defective compensator of the color image sensor which amends the signal of the defect pixel in the color image sensor equipped with two or more arranged pixels The defective data generator which outputs the signal which shows the location of the defect pixel of said color image sensor, The defective compensator for luminance signals for acquiring the luminance signal by which defective amendment was carried out by replacing the signal of said defect pixel based on the signal from said defective data generator by the

average of the signal of the pixel which adjoins irrespective of the color of the pixel, or the signal of two or more adjoining pixels, It is a defective compensator for chrominance signals for acquiring the chrominance signal by which accepted the signal from said defective compensator for luminance signals, and defective amendment was carried out based on the signal from said defective data generator. attention water -- water parallel of parallel both sides -- if -- the average of the signal of a pixel which left 2 pixels of signals of a defect pixel before and after the horizontal -- replacing -- attention water parallel -- if -- A defect pixel replaces the signal of this defect pixel by the average of the signal of a pixel which left 2 pixels before and after level, red or when blue. By replacing the signal of this defect pixel by the average of the signal of four pixels before and after the slanting upper and lower sides, and performing re-amendment, when a defect pixel is green Said defective compensator for chrominance signals for acquiring the chrominance signal by which defective amendment was carried out, and the color separation circuit which outputs the chrominance signal of each primary color using the chrominance signal with which water parallel of the both sides of said attention water parallel by which defective amendment was carried out, and these attention water parallel were amended are prepared.

[0021] With the above-mentioned configuration, a color image sensor has the

pixel array called the so-called green check and red-and-blue line sequential. In such a case, when the defective compensator for luminance signals performs defective amendment of a luminance signal by the average of the signal of the adjoining pixel, or the signal of two or more adjoining pixels, it is rare to lose the high resolution component of a luminance signal, and a defect can be prevented from being conspicuous. moreover -- a chrominance signal -- attention water -- parallel -- the water of the both sides -- the attention water which performs defective amendment to three parallel water parallel -- water parallel of parallel both sides -- if -- defective amendment can be performed by the signal of the same color about all colors by replacing the signal of a defect pixel by the average of the signal of a pixel which left 2 pixels before and after level. Moreover, in attention water parallel, when a defect pixel replaces by the average of the signal of a pixel which left 2 pixels before and after level red or when blue, the signal of the same color can amend. Moreover, when a defect pixel is green, amendment in which a defect is not conspicuous can be performed by replacing by the average of the signal of the pixel of the four same colors before and after the slanting upper and lower sides. Thus, the chrominance signal of all primary colors is generable by the color separation circuit using the chrominance signal from three water parallel by which defective amendment was carried out.

[0022] In this case, it is convenient, if said defective compensator for luminance signals performs defective amendment processing after performing white balance processing to the signal from said color image sensor.

[0023] After performing white balance processing, by performing defective amendment for luminance signals with the defective compensator for luminance signals, an equipment configuration can be simplified and suitable amendment can be performed. Since this will not be concerned with the color of a defect pixel if white balance processing is performed and the level of the chrominance signal of each color is adjusted beforehand, and that you may replace with the signal of a defect pixel simply does not only need level adjustment etc. with the signal of a contiguity pixel, an equipment configuration is simplified.

[0024]

[Embodiment of the Invention] Hereafter, with reference to a drawing, it explains per defective compensator of the color image sensor concerning this invention. Drawing 1 shows the digital disposal circuit of the veneer color camera containing the defective compensator concerning 1 operation gestalt of this invention. The equipment of drawing 1 shows the configuration in the case of using the image sensor equipped with the primary color filter of the array shown in said drawing 7 .

[0025] The defective compensator of the color image sensor of drawing 1 is

equipped with the amplifier 1 which amplifies the signal from the image sensor which is not illustrated, A/D converter 2 which changes the signal of an amplifier 1 into a digital signal, the white balance circuit 3 which carries out white balance processing to the digital video signal supplied from A/D converter 2, and the white balance data generating circuit 4 which supplies data required for white balance processing to the white balance circuit 3.

[0026] The defective amendment circuit 5 for luminance signals where the equipment of drawing 1 performs defective amendment for luminance signals to the output of the white balance circuit 3 again, The gamma correction circuit 7 which carries out gamma amendment to the signal which is outputted from the defective amendment circuit 5 for luminance signals, and by which defective amendment was carried out, The output signal of a gamma correction circuit 7 1 level period every, respectively 1H delay circuits 8 and 9 to delay, The defective data generating circuit 6 which supplies the control signal for defective amendment of an image sensor to the defective amendment circuit 5 for luminance signals, and the defective data generating circuit 6 are equipped with the defect ROM 16 for defective tab control specification in which the information which shows a defective location is offered.

[0027] Furthermore, the equipment of drawing 1 is equipped with the encoder 13 which generates a luminance signal Yl and the coloring matter signals Cr and Cb

from the output of the color separation circuit or color decoder 12 which generates a chrominance signal from three signals of level Rhine by which defective amendment was carried out in the defective amendment circuit 11 for chrominance signals which performs defective amendment of a chrominance signal based on the signal from the defective data generating circuit 6, and the defective amendment circuit 11 for chrominance signals, and a color decoder 12.

[0028] Furthermore, the equipment of drawing 1 is equipped with the luminance-signal processing circuit 10 which generates the horizontal profile signal Yh and the vertical profile amendment signal Yhl, the luminance-signal resolution amendment circuit 14 which generates the luminance signal (Yout) of high resolution, and the system pulse generating circuit 15 which supplies a clock pulse required for each part of equipment, a control pulse, a synchronization pulse, etc. based on the signal by which defective amendment was carried out in the defective amendment circuit 5 for luminance signals.

[0029] In the equipment of drawing 1 , the signal of a different color is outputted by point sequential according to the scan of the pixel array the signal from the image sensor 17 driven by the drive circuit 18 is indicated to be to drawing 7 . The signal of each [these] color is an analog video signal, is amplified by the amplifier 1 and inputted into back A/D converter 2 which had direct current level adjusted by the clamping circuit which is not illustrated. In A/D converter 2, A/D

conversion is sampled and carried out for every pixel, and it is changed into a digital video signal.

[0030] This digital video signal is a signal with which colors differ one by one for every pixel, and in the white balance circuit 3, it is adjusted so that the signal of R and B may become the same magnitude as the signal of G when it multiplies by the white balance data generated in the white balance data generating circuit 4 according to the color for every pixel and white is picturized for example.

[0031] The defective amendment circuit 5 for luminance signals performs point defect amendment for luminance signals by the contiguity pixel irrespective of the color of a defect pixel according to the control signal to which the output of the white balance circuit 3 is supplied from the defective amendment control signal generating circuit 6.

[0032] The defective amendment control signal generating circuit 6 supplies the control signal of defective amendment to the defective amendment circuit 5 for luminance signals, and the defective amendment circuit 11 for chrominance signals according to the data stored in the memory 16 for defective tab control specification. The memory 16 for defective tab control specification is made to have memorized beforehand with the equipment which is a **** programmable ROM, and the manufacturer of a camera investigates the location of the point defect of each image sensor proper, and does not illustrate it all of a sudden.

[0033] A gamma correction circuit 7 performs well-known gamma amendment to the signal by which defective amendment was carried out from the defective amendment circuit 5 for luminance signals. in this case -- since white balance is taken beforehand in the white balance circuit 3 -- each color community -- one circuit, for example, a ROM table, -- it can come out and finish.

[0034] The sequential input of the output signal of a gamma correction circuit 7 is carried out in 1H delay circuits 8 and 9. 1H delay circuits 8 and 9 delay 1 horizontal-scanning period signal, respectively, in order to perform signal processing of the perpendicular direction of a scan pixel. The signal with which DL1 and DL1 carried out 2 level period delay of the signal which carried out 1 level period delay of the signal which is not delayed through DL0 and the IH delay circuit 8 through 1H delay circuit 9 once again is set to DL2.

[0035] Next, in the luminance-signal processing circuit 10, said signals DL0, DL1, and DL2 calculate, and the horizontal profile signal Yh and the vertical profile amendment signal Yhl are created. Thus, since the high resolution components Yh and Yhl of a luminance signal are made by the signal by which defective amendment was carried out by the signal from the pixel which adjoins a defect pixel, they are not conspicuous as a defect of brightness.

[0036] Using said signals DL0, DL1, and DL2, the defective amendment circuit 11 for chrominance signals performs defective amendment by the complement

from the signal of the same color in response to the control signal from the defective amendment control signal generating circuit 6 so that it may explain to a detail later.

[0037] Thus, in a color decoder 12, color separation of each signal of DL0, DL1, and DL2 by which blemish amendment was carried out in the defective amendment circuit 11 for chrominance signals is carried out, and each chrominance signal of (Red R) green (G) blue (B) is created.

[0038] Furthermore, in the encoder circuit 13, a luminance signal (YI) and two color-difference signals (Cr, Cb) are agreed with this contractor using the matrix circuit known well. Moreover, the luminance-signal resolution amendment circuit 14 is processed using the luminance signal YI, the level high resolution component Yh from the luminance-signal processing circuit 10, and the perpendicular profile amendment signal YhI which were created in the encoder circuit 13, and creates the high resolution luminance signal Yout.

[0039] The luminance signal Yout generated as mentioned above and color-difference signals Cr and Cb are recorded with the recording device and monitoring device which are not illustrated, for example, or graphic display is carried out.

[0040] Drawing 2 showed the concrete example of a configuration of the defective amendment circuit 5 for luminance signals, and is equipped with the

delay circuit 31 and the change circuit 32 for 1 pixel. The output video signal OUT is changed to the signal which changed when the brightness defective signal YCOMP which shows the location of a point defect entered, and passed along the delay circuit 31 by the circuit 32 from the input video signal IN, a defect pixel is replaced with the signal of a pixel on the left according to the sequence of a scan, and a point defect is amended.

[0041] Drawing 3 shows the concrete example of a configuration of the luminance-signal processing circuit 10. In this drawing, 41 and 42 are addition circuits, and after they add two input signals, respectively, they are set to 1/2. 43 and 44 are sampling circuits and that of G_S/H1 and G_S/H2 samples an input signal by the sampling signal, respectively. 45 is a subtraction circuit. 46 is a delay circuit for 1 pixel.

[0042] In the circuit of drawing 3 , said signals DL0 and DL2 are added in the addition circuit 41. In order that this added signal may be added in said signal DL 1 and addition circuit 42 and may double a phase, it is delayed by 1 pixel and outputted as a high resolution luminance signal Yh in a delay circuit 46. That is, the high resolution luminance signal Yh is expressed as follows.

[Equation 1] Yh= (DL0+2*DL1+DL2)/4 -- although it is high resolution horizontally by doing in this way, perpendicularly, the luminance signal which averaged each color with low resolution is acquired. In addition, although this

luminance signal differs from the luminance signal of the rate of color mixing of normal, by making it such a configuration, 4th high order more than filtering can be performed in the below-mentioned perpendicular profile amendment circuit, the harmonic content of a chrominance signal is stopped, and composition of the luminance signal of high resolution is attained. Horizontal high order filtering is realizable in the comparatively easy circuit known well.

[0043] The signal which added signals DL0 and DL2 and was acquired is sampled in a sampling circuit 44 again according to the phase of the green signal of correspondence level Rhine. Moreover, according to the phase of the signal of correspondence level Rhine green, it is sampled in a sampling circuit 43, and subtracts with the sign illustrated by the output and the subtraction circuit 45 of a sampling circuit 44, and the signal of DL1 outputs a luminance signal Yhl. It is because a color error will be enlarged if it can extract only from a green component when the perpendicular profile component which can be created from signals DL0, DL1, and DL2 carries out vertical high order filtering to others and it does not carry out average processing so that drawing 7 may show, but other color components are used. Moreover, there is much vertical high order filtering by the additional degree, it needs to carry out 1H delay circuit, and enlarges a circuit scale.

[0044] Drawing 4 shows the example of a concrete configuration of the

luminance-signal resolution amendment circuit 14. As for an addition circuit and 52, in this drawing, 51 and 54 are [a low pass filter and 53] level profile amendment circuits.

[0045] In the circuit of drawing 4 , first, the perpendicular profile amendment signal Yhl of the luminance-signal processing circuit 10 is added to the brightness output Yl of the encoder circuit 13 by the addition circuit 51, by letting a low pass filter 52 pass, vertical definition is high and the luminance signal which the brightness mixing percentage of normal with low horizontal resolution required is acquired in this signal that did sums. By adding the level profile amendment signal extracted from the signal which passed along the low pass filter 52, and the high resolution luminance signal Yh of the output of the luminance-signal processing circuit 10 by the level profile amendment circuit 53 in the addition circuit 54, as for a low resolution component, the luminance signal of the rate of color mixing of normal is acquired [a perpendicular and a horizontal] for Yout with high resolution. Since a point defect does not carry out error propagation in the large range by such processing, the point defect of a luminance signal is amended finely.

[0046] Drawing 5 shows the example of a concrete configuration of the defective amendment circuit 11 for chrominance signals. 61a-61l. are delay circuits, performs signal delay for a 1-pixel clock, respectively, and enables it to process

the signal of a pixel which left only the number of delay circuits to coincidence in this drawing. 62a-62f perform addition and its average processing (processing set to one half by the bit shift) of two signals which are average addition circuits and are inputted, respectively. Moreover, 63, 64, 65, and 66 are signal change circuits, and change a signal according to the signal of change signal DL0COMP, DL2COMP, DL1COMP, and GCOMP, respectively.

[0047] In the circuit of drawing 5 , defective amendment to the signal corresponding to the pixel train of a signal DL 0 and a signal DL 2 is performed by asking for the average of the signal left 2 pixels before and behind [of the same color as a defect pixel] level as each amendment signal by 62e as well as average addition circuit 62b, respectively, even if it is which color. These amendment signals perform defective amendment by the thing which synchronized with each defective signal location and which it changes and is changed to the signal of a defect pixel in the change circuits 63 and 64 according to signal DL0COMP and DL2COMP, respectively. For example, it will be replaced with R or G of the signal with which the 2 pixels of the same colors of the same pixel train as a defect pixel got mixed up if signals DL0 and DL2 are signals of a pixel train with which a red signal (R) and a green signal (G) are outputted by turns. It is the same even if signals DL0 and DL2 are signals with which a green light (B) and G are outputted by turns.

[0048] The defective amendment to the signal corresponding to the pixel train of a signal DL 1 is changing the amendment approach by the case where the signal of a defect pixel is a G signal, and the case where they are R or B signal.

[0049] When a defect pixel is R or B signal, defective amendment is performed by asking for the average of the signal which left 2 pixels before and after [of the same color as a defect pixel] level like defective amendment of the signal corresponding to the pixel train of the above-mentioned signal DL 0 and a signal DL 2 by average addition circuit 62c, changing in the change circuit 65, and replacing a defect pixel according to signal DL1COMP.

[0050] When a defect pixel is G signal, it is 4 pixels which left the 1 pixel of the maximum contiguity pixels of the same color before and after the slanting upper and lower sides, and defective amendment is performed by asking for those averages in the average addition circuits 62a, 62d, and 62f, changing it, changing in a circuit 66, and changing to a defect pixel according to Signal GCOMP.

[0051] Drawing 6 shows the example of a concrete configuration of the chrominance-signal separation circuit 12, and it carries out color separation using signal DL0' by which defective amendment was carried out in the defective amendment circuit 11 for chrominance signals, DL1', and DL2'. 76 is an average addition circuit and is a circuit which adds and averages DL0' and DL2'. 71, 72,

and 73 are sampling circuits and are sampled with the sampling control signals SH0, SH1, and SH0, respectively. 74 and 75 are the Rhine change circuits.

[0052] In the circuit of drawing 6 , G signal is sampled by the control signal SH0 from signal DL1' in a sampling circuit 73 according to the phase of the pixel. Since R signal and B signal change Rhine which comes out by turns, the processing complemented with Rhine of order is made in Rhine which is not outputted. It asks for the average of signal DL0' and DL2' in the average addition circuit 76, and R of correspondence level Rhine or B signal is sampled in a sampling circuit 71. The output of a sampling circuit 71, and B or R signal which sampled signal DL1' in the sampling circuit 72 is changed using the Rhine change circuits 74 and 75 and the Rhine change signal LINE, and it considers as R signal and B signal, respectively. Since defective amendment of all the signals to be used is carried out at this time, a defect is not conspicuous. Each chrominance signals R, G, and B which were acquired as mentioned above and by which defective amendment was carried out are inputted into the well-known encoder 13, and two color-difference signals Cr and Cb and a luminance signal YI are created.

[0053]

[Effect of the Invention] As mentioned above, according to this invention, the defective compensator with which the high resolution component of a luminance

signal is not lost in a comparatively easy equipment configuration in a luminance signal and a chrominance signal since defective amendment can be performed by the optimal, respectively different approach, and a defect is not more conspicuous is realizable.

[0054] Since it amends especially about a luminance signal by the pixel which adjoins the signal of a defect pixel irrespective of the color of the pixel and amends by the signal of the pixel near the same color about a chrominance signal, the high resolution component of a luminance signal is not lost and the defect of brightness stops being conspicuous in this invention. Moreover, since it amends by the signal of the same color also about a chrominance signal, the defect by difference of a color is not conspicuous.

[0055] Furthermore, the signal of the pixel which adjoins irrespective of the color of a pixel beforehand to the output signal from a color image sensor performs defective amendment for luminance signals, and it constitutes from this invention so that the signal of the pixel near the same color may maximum-amend the signal with which amendment for luminance signals was performed about the signal for generating a chrominance signal after that. For this reason, a new defective amendment circuit can be incorporated also utilizing the existing circuit appropriately, and an equipment configuration can also be simplified.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the configuration of the video-signal processing circuit containing the defective compensator of the color image sensor concerning 1 operation gestalt of this invention.

[Drawing 2] It is the block circuit diagram showing the configuration of the outline of the defective amendment circuit for luminance signals in the circuit of drawing 1 .

[Drawing 3] It is the block circuit diagram showing the configuration of the luminance-signal processing circuit in the equipment of drawing 1 .

[Drawing 4] It is the block circuit diagram showing the configuration of the luminance-signal resolution amendment circuit in the circuit of drawing 1 .

[Drawing 5] It is the block circuit diagram showing the configuration of the defective amendment circuit for chrominance signals in the circuit of drawing 1 .

[Drawing 6] It is the block circuit diagram showing the detailed configuration of the color separation circuit in the circuit of drawing 1 .

[Drawing 7] It is the partial top view showing the pixel array of the color image sensor which uses the defective compensator concerning 1 operation gestalt of

this invention.

[Description of Notations]

1 Amplifier

2 A/D-Conversion Circuit

3 White Balance Circuit

4 White Balance Data Generating Circuit

5 Defective Amendment Circuit for Luminance Signals

6 Defective Amendment Control Signal Generating Circuit

7 Gamma Correction Circuit

8 Nine 1H delay circuit

10 Luminance-Signal Processing Circuit

11 Defective Amendment Circuit for Chrominance Signals

12 Color Separation Circuit or Color Decoder

13 Encoder Circuit

14 Luminance-Signal Resolution Amendment Circuit

15 System Pulse Generating Circuit

16 Memory for Defective Tab Control Specification